Appendix D. Results from Quality Control Analysis for Continuous Monitoring of Water Temperature, Specific Conductance, Dissolved Oxygen, pH, Turbidity, and Total Chlorophyll in the Yakima River, Washington, 2004–07

The USGS guidelines for continuous monitor operation specify that continuous water-quality data be corrected by applying calibration and (or) fouling corrections that are determined during routine monitor maintenance or when a monitor is removed from service. A correction for a parameter is required when the sum of the absolute values for calibration and fouling drift error exceeds the value shown in table D1 (no data-correction criterion exists for total chlorophyll).

Data quality ratings for the monitor deployments were determined by considering two factors: (1) how closely the operation and maintenance for the monitors followed the specifications in the USGS guidelines, and (2) the sum of the absolute values of the calibration and fouling corrections applied to the data. Table D2 shows the ratings for the monitor deployments at Kiona between 2004 and 2007, the spring and summer monitor deployment at Mabton in 2005, and the spring and summer monitor deployments at Zillah in 2006 and 2007.

To determine how representative the data obtained from the monitor were of the entire stream, cross-sectional measurements were made at the monitoring sites for temperature, specific conductance, dissolved oxygen, and pH at Kiona in 2004–07, Mabton in 2005, Zillah in 2005–06, and many of the short-term sites monitored in 2004. The results are shown in table D3.

Table D4 summarizes the differences between the Clark cell and optical dissolved oxygen probes during the period when both probes were in use.

Table D1. U.S. Geological Survey criteria for water-quality data corrections.

[Data-correction criteria from Wagner and others, 2006. No data-correction criterion for total chlorophyll. **Abbreviations:** °C, degrees Celsius; µS/cm, micosiemens per centimeter; ±, plus or minus; mg/L, milligram per liter; NTU, Nephelometric Turbidity Unit]

Parameter	Data-correction criteria
Temperature	± 0.2°C
Specific conductance	The greater of + 5 µS/cm or ± 3 percent of the measured value, whichever is greater
Dissolved oxygen	± 0.3 mg/L
pH	± 0.2 pH units
Turbidity	The greater of ± 2 NTU or ± 5 percent of the measured value, whichever is greater

Table D2. Quality control ratings for continuous water-quality monitoring gaging stations, Yakima River at Kiona, water years 2004–07, Mabton, 2005, and Zillah, Washington, 2005–06.

[Values represent the percentage of time when the monitor was deployed when data were rated as excellent, good, fair, and poor. na, not applicable; –, no data]

Rating	Water year							
	2004	2005			2006			2007
	Kiona	Kiona	Mabton	Zillah	Kiona	Kiona–optical	Zillah	Kiona
Water temperature, in degrees Celsius								
Excellent	0	100	100	100	100	–	100	100
Good	100	0	0	0	0	–	0	0
Fair	0	0	0	0	0	–	0	0
Poor	0	0	0	0	0	–	0	0
Specific conductance, in microsiemens per centimeter								
Excellent	0	68	100	100	57	–	100	50
Good	100	27	0	0	38	–	0	40
Fair	0	6	0	0	4	–	0	5
Poor	0	0	0	0	0	–	0	5
Dissolved oxygen, in milligrams per liter								
Excellent	0	0	0	27	[1]75	100	70	95
Good	85	72	47	32	[1]18	0	18	4
Fair	9	14	31	11	[1]5	0	7	1
Poor	6	14	22	30	[1]2	0	5	0
pH, in standard units								
Excellent	0	64	83	87	78	–	87	87
Good	100	27	17	13	19	–	13	13
Fair	0	8	0	0	3	–	0	0
Poor	0	0	0	0	0	–	0	0
Turbidity, in nephelometric turbidity units								
Excellent	0	0	100	43	94	–	100	51
Good	100	51	0	57	1	–	0	21
Fair	0	26	0	0	1	–	0	11
Poor	0	13	0	0	5	–	0	16
Total chlorophyll, in micrograms per liter								
Excellent	0	0	0	0	87	–	na	na
Good	0	79	78	23	2	–	na	na
Fair	100	21	22	25	2	–	na	na
Poor	0	0	0	52	9	–	na	na

[1]Clark cell.

Table D3. Cross-sectional measurements of water temperature, specific conductance, dissolved oxygen, and pH, Yakima River, Washington, 2004–07.

[The Kiona and Zillah monitors were installed near the left bank of the river; the Mabton monitor was installed at the center of the river. The Kiona bridge is 630 feet downstream of the Kiona monitor. **Abbreviations:** RM, river mile; °C, degrees Celsius; µS/cm, microsiemens per centimeter; mg/L, milligram per liter]

Location	Measurement	Parameter			
		Temperature (°C)	Specific conductance (µS/cm)	Dissolved oxygen (mg/L)	pH (standard units)
Yakima River at Kiona (RM 30; 12510500), 2004–07—27 comparisons					
Maximum absolute difference between monitor reading and cross-sectional readings taken downstream at Kiona bridge.	Median	0.10	4	0.69	0.12
	90th percentile	0.81	12	1.86	0.63
Maximum absolute difference between monitor reading and reading taken at left bank of river at Kiona bridge.	Median	0.09	3	0.63	0.10
	90th percentile	0.37	10	2.04	0.36
Maximum absolute difference between reading taken one foot from the bottom and one foot from the surface at the Kiona bridge.	Median	0.01	0	0.01	0.01
	90th percentile	0.02	0	0.05	0.02
Yakima River near Mabton (RM 55; 12509060), 2005—4 comparisons					
Maximum absolute differences between the monitor location and cross-section stations	Median	0.07	3	0.44	0.11
Differences between 1-foot from the bottom and 1-foot from the surface at the Mabton siphon.	Median	0.00	0	0.02	0.01
Yakima River above East Toppenish Drain near Granger (Zillah; RM 87; 12505330), 2005–06—9 comparisons					
Differences between the monitor location and cross-section stations.	Median	0.13	1	0.70	0.12
Differences between the monitor location and cross-section stations.	90th percentile	0.28	3	1.40	0.84
Maximum absolute difference across the cross-section at various sites, 2004					
12487000 Yakima River at Selah Gap near North Yakima (RM 117).	Single values	0.31	6	0.67	0.03
12499000 Naches River near North Yakima (RM 1).	Single values	0.20	0	0.34	0.20
12504490 Sunnyside Canal at Diversion near Parker (RM 104).	Single values	0.02	1	0.51	0.03
12507584 Yakima River at Murray Road near sunnyside (RM 72).	Single values	0.21	0	0.87	0.03
12509900 Yakima River above Chandler Pump near Whitstran (RM 37).	Single values	0.31	8	0.55	0.02
12511000 CID Canal at Horn Rapids Dam near West Richland (RM 18).	Single values	0.01	0	0.03	0.01
12511800 Yakima River at Van Giesen Bridge near Richland (RM 8).	Single values	0.12	1	0.61	0.06

Table D4. Comparison of concurrent dissolved oxygen measurements made by a Clark cell probe and optical probe at the Yakima River at Kiona (river mile 30), Washington, July 6, 2006–February 1, 2007.

Parameter	Daily dissolved oxygen concentration		
	Minimum	Mean	Maximum
10th percentile of difference (optical–Clark)	-0.20	-0.18	-0.20
Median of difference (optical–Clark)	0.05	0.07	0.15
90th percentile of difference (optical–Clark)	0.40	0.39	0.60